

ABSTRACT OF THE DISCLOSURE

An image display system provides a viewer with an experience of 3-D as seen in real life by presenting at least two planar images at different depths, e.g. for a computer monitor. Not only is such a system relatively low in cost and remarkably easy to use, but video images in accordance with this invention can be transmitted using much less bandwidth than other 3-D imaging techniques. Such apparatus presents the images in positions whereby each is optically spatially separated from the other (often along a co-axial line-of-sight for a viewer (i.e. co-aligned)). The display provides traditional 2-D cues, parallax, lateral binocular disparity and depth disparity. Such apparatus desirably employs at least one optical element as a beamcombiner, optionally a semi-silvered mirror or a refractive element such as the Fresnel semi-prism disclosed herein. The foreground image plane appears transparent except where there are objects, allowing objects on the background image plane to be seen when not obscured by foreground objects. In many embodiments, it is preferred that background objects are not visible through images of opaque objects in the foreground. Various techniques for the formation of such images are disclosed, including techniques of controlling relative brightness of the two images, dimming out portions of the background image that are occluded by the foreground image, and using a mask such as a light valve in the image path to occlude portions of the background image that are behind foreground objects. Additionally, disclosed are other techniques to determine whether a portion of a transmitted image is to be displayed on the foreground or background including image capture from a pair of vantage points, flashing a reference grid on the scene and calculating depth therefrom, creating depth information as a byproduct of computer animation, etc. Some embodiments use at least one lens to create a real image as part of the display; others present virtual images. Disclosed are various housings adapted to be fastened to a CRT or other image source, providing an aperture through which a viewer observes the display. The apparatus may employ

relatively inexpensive annular lenses disclosed herein, that nevertheless minimize scatter and flare by employing a light-absorptive element adjacent the vertical rises of the lens to minimize the amount of light passing through and reflected from the rises. A sandwich of such optical elements provides a compact and lightweight display adapter that can be placed in front of a CRT on which the foreground and background are shown on the top and bottom respectively. The sandwich comprises the Fresnel semi-lens disclosed herein, aligned with a Fresnel beam combining element, e.g. a Fresnel semi-prism disclosed herein. The viewer sees two images, one at about the plane of the CRT screen and another a few inches behind it. If aspect-ratio correction is desired, the image source is compressed on the CRT screen and a Fresnel cylinder lens is disposed in front of the aforesaid sandwich. Also disclosed is a multiplayer/multiuser video adapter, allowing two or more users to share a single image source and yet have mutually independent and "secret" 3-D (or 2-D) views of a screen. A virtual monitor is disclosed that minimizes glare that would otherwise reflect from a CRT screen, provides improved security through controlled angle of view, and reduces exposure to radiation. In a "decoder" embodiment, the foreground and background each contain incomplete parts of an overall image or message, so only the viewer of both co-aligned images sees the overall image or message.